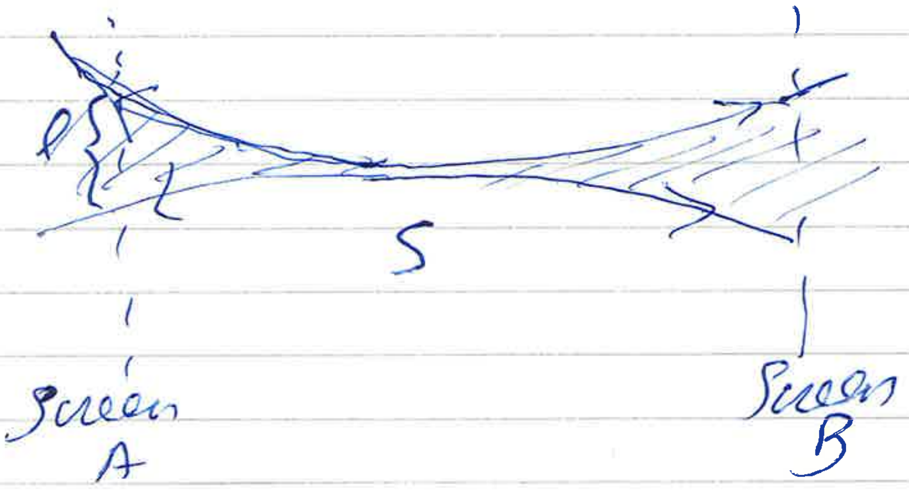
Dear Sir Karl,

Thank you for sending me the details of your very interesting thought experiment. Let me say at once that my initial reaction when we discussed it on the telephone, that decorrelation effects which arise as the particles separate in the original version of the EPR argument (which were overlooked by Einstein, although pointed out in unpublished work by Epstein — see also my paper Experimental Tests of ~~the~~ Quantum Theory p. 16, ~~[illegible]~~ para 1 for discussion of this point and an estimate of the decorrelation as a function of the distance of the ~~det~~ detector from the source) would perhaps spoil your argument is not correct. Since, as you pointed out, such effects can be controlled by decreasing the distance between source and ~~detector~~ screen in your example (or equivalently by increasing the velocities of the particles at right angles to the screen). [~~There is however I believe another more fundamental difficulty with the example which will occur to me~~] There are, however, other difficulties that occur to me. You are not explicit about the wave functions you are assuming for the outgoing particles, except that the transverse positions q_{xA} and q_{xB} are strongly correlated. Let us examine two cases in detail—

1.) Suppose first that the correlation between q_{xA}, q_{xB} arises since both are sharply correlated with a fixed location for the source. So the dependence of the total wave function on the transverse components of position would be something like $\delta(q_{xA} - h)\,\delta(q_{xB} - h)$ ~~ma~~ where h gives the precise transverse location of the source. We have then that $q_{xA} = q_{xB} = S$ initially. As the particles separate the two δ-functions "diffuse" so the appearance of the two beams looks like this



At the location of screen A and screen B the decorrelation is such that *precise* measurement of q_{xB} only identifies q_{xA} to a range of order l, where l is the width of the beam of A particles where it reaches screen A; the resulting scatter at A would be of order $\hbar/l$. Suppose we start with two very narrow slits of width $d \ll l$ at A and B we get scatters of order $\hbar/d$. As slit A is opened scatter at A will decrease until $d \approx l$ to the value $\hbar/l$ predicted by Copenhagenists as a result of the slit at B still being very narrow, but further widening of slit A will not produce any further decrease in scatter which is now controlled by the 'intrinsic' de Broglie dispersion of the beam. In other words the predictions of QM and the Schrodingerists are exactly the same in respect of the variation in scatter ~~below~~ behind slit B as B is widened.

The argument does not depend on the existence of decorrelation, i.e. it ~~does not~~ still applies if the A and B screens are moved close in to S. The source of the scatter in momentum behind the wide slit is just the range of transverse momenta required to achieve the 'narrow' initial beam at S.

2) Suppose the wave function at S in respect of the x-coordinates of the two particles is an EPR one, i.e. an eigenstate of $q_{xA}-q_{xB}$ and of $p_{xA}+p_{xB}$. The situation now is quite different from case ①. Since q_{xA} and q_{xB} separately no longer have sharp values. The scattering of such an EPR state by the two slits can now easily be shown to correspond to a continuous line of 'incoherent' sources disposed ~~along the~~ parallel to the two screens. We now get

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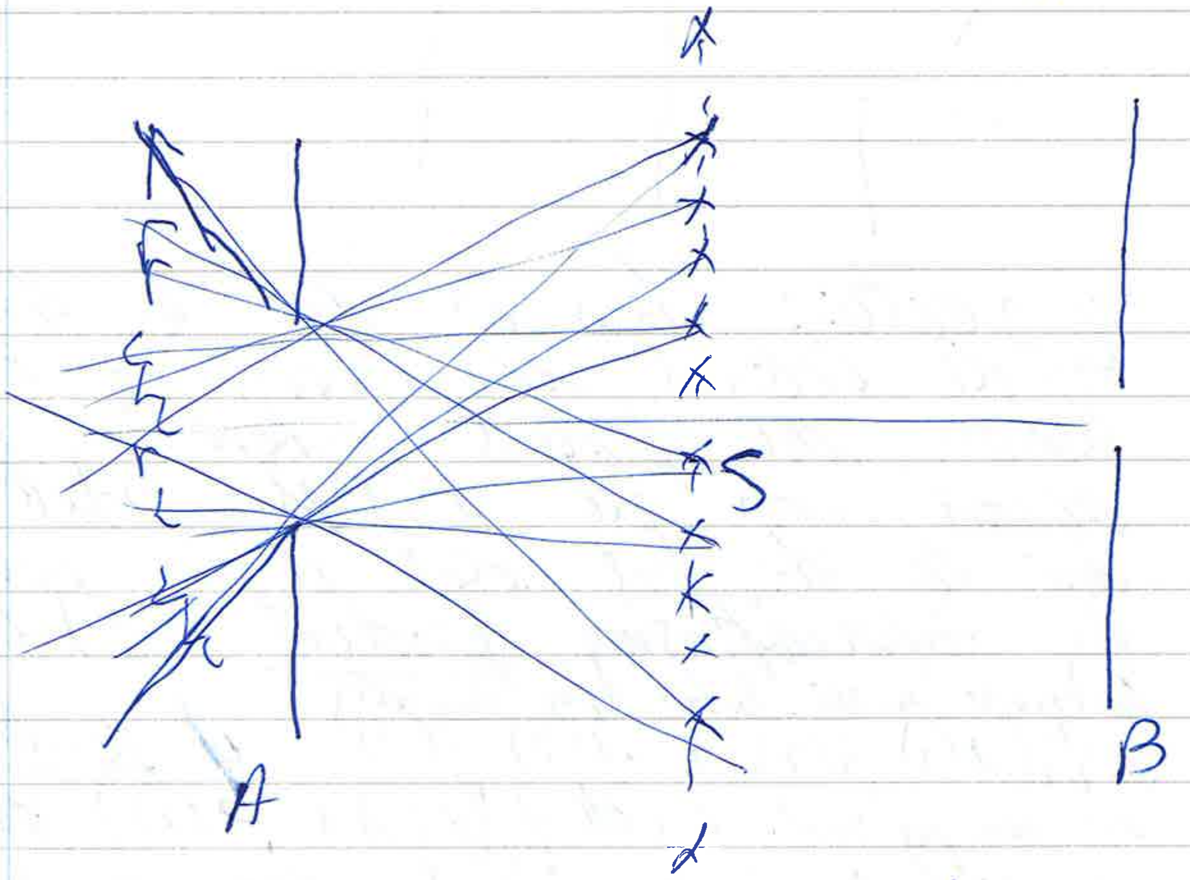
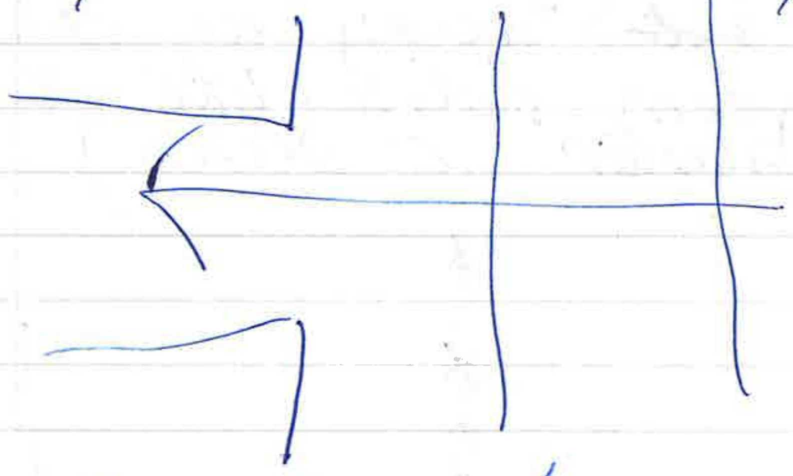
large scattering for slit A narrow, a wide ~~[illegible]~~ arising as sketched in the diagram below (where the wide slit situation is shown)



Again the Copenhagen prediction of large scatter for a wide slit at A is also what QM predicts. The range of directions ~~between~~ behind the slit in A now arises not because of diffraction effects but because of the range of ~~incoming momenta~~ directions for the incoming particles, i.e. arises again from the range in p_{xA} which is a feature of the EPR state (corresponding to the fact that q_{xA} is not sharp, only $q_{xA} - q_{xB}$)
Noted in particular the difference from the scattering of a plane wave

PTO

By a wide slit , ~~the observed~~



The absence of scatter here is due to coherence in the lateral dimension of ~~the~~ beam the feature which is absent in the EPR state due to the fact that it is achieved by superimposing product states.

(For example in the Bohm spin example
$\frac{1}{\sqrt{2}}(\alpha(1)\beta(2) + \alpha(2)\beta(1))$ is incoherent as compared with $\frac{1}{\sqrt{2}}(\alpha(1) + \beta(1))$ ~~[illegible]~~ in respect of measurements done on particle (1))

So in neither of these two cases does the Copenhagen interpretation predict anything differently from dBH (and new kind hence [illegible] new experiment). Finally ~~Indeed~~ there are general proofs in the literature that the statistics of any measurement on A cannot be affected by what measurement one does on B in the EPR situation. The most recent is by Ghirardi, Rimini and Weber ~~N. C. L.~~ ~~Nuovo Cimento Letters~~ Lettere al Nuovo Cimento 27 (1980) 293.

I would be interested to hear your reaction to these comments. I have not had time to read through the paper by Ulrich Hoyer. I will write to you later about this.

With best wishes

Yours sincerely-

P.S. Sorry I could not ring you on Tuesday evening — my car broke down and I did not get home until 1 a.m.! I hope you have a ~~good~~ nice time in Halstead.